

3rd LCLUC Science Team Meeting

Airlie House, Warrenton, Va

May 18-21 1999

Objectives of the Science Team Meeting

- **Program Updates**
 - current status of NASA LCLUC
 - the first years: a retrospective
 - status of LCLUC across USGCRP - US Carbon / HD / National Assessment
 - status of IHDP / IGBP LUCC
 - LCLUC related meeting reports - community updates
- **Presentation of Early Results from Round 1 Funding**
 - research findings and identification of mid-course corrections
 - new methods, emerging theories and conceptual advances, policy and resource management implications
- **Planning for Packaging of Round 1 and LBA LCLUC early results**
 - identification of significant results, major achievements
 - An LCLUC Book - plans and potential contributions
 - LCLUC Web site update and LCLUC outreach initiatives
 - assess role of LCLUC in regional assessments
- **LCLUC data initiatives**
 - regional CD's, LC ESIPS, Fire Web
 - Landsat 7 status, follow-on rationale and data needs
- **Science Team input to future directions of NASA - LCLUC**
- **Future NASA missions and LCLUC - post Easton**

Audiences and Approaches

Scientific Community (Primary Audience)

Peer reviewed papers / Conference presentations / Special Editions
Project data and products - partner with ESIPS / PI Web Sites / Regional data CD's
LCLUC Book: case studies, methods, emerging theories, comparisons, synthesis
Regional / Thematic Scientific Networks (e.g. Miombo / SEASIA)

NASA Management

Summary achievements; keeping it up to date (*Focus for this afternoon*)
Back up material / LCLUC WEB (format, attribution) - project scientist
Abstracts - Annual Reporting - Publications list - Web Site
IWG ?? WG's - presentations - LCLUC results overview presentation

Science / Policy 'Brokers' (e.g. OSTP / WRI / etc)-

cautious translation of hard results into policy context, press release management
LCLUC areas of emphasis - carbon FCCC / national assessments
NASA LCLUC and Carbon Workshop 2000 - policy participation
rapid response mechanism e.g. NASA Fire Web Site, SAFARI, % cover Poster

Land Management Community

targeted topical workshops (funding opportunities ?)
involvement in national / regional assessments - land use stakeholders
partner with RESACS - applications program

Education / Public Outreach

Web Site - tutorials - slide show - page links

Significant Results Might:

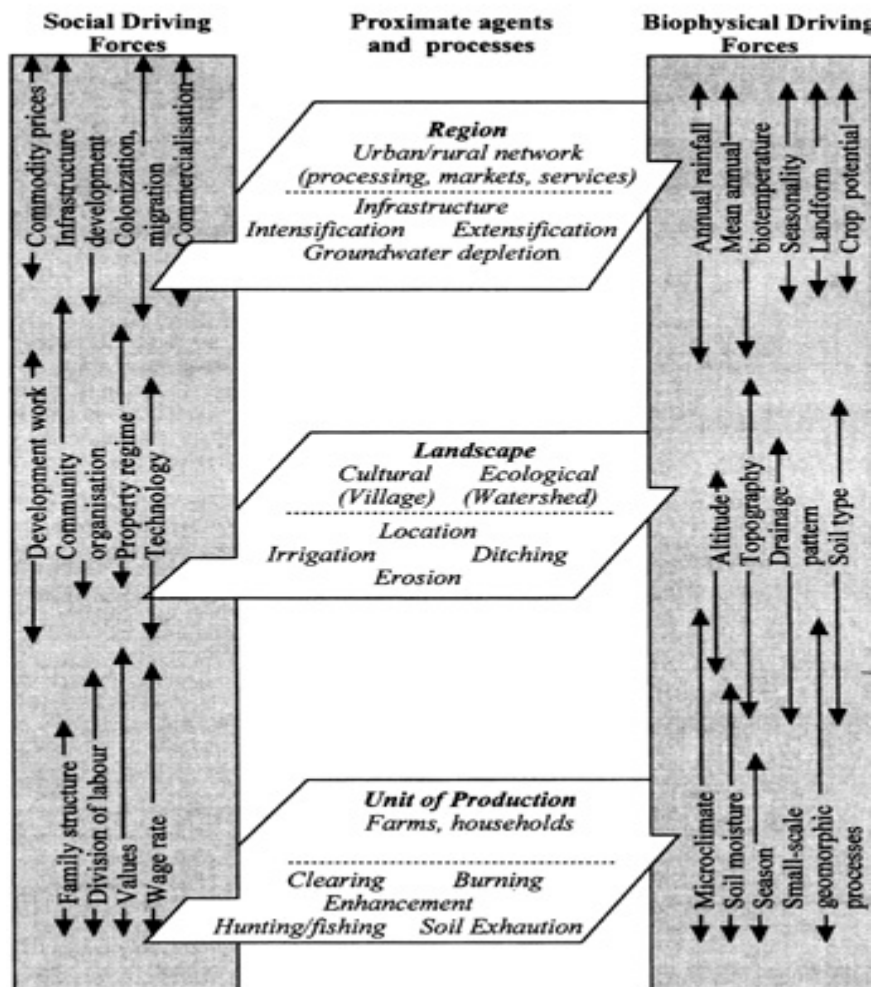
- **Provide a new insight or advance in our understanding of the processes taking place**
- **Contradict or confirm current theory**
- **Answer some outstanding research question**
- **Quantify the drivers or impacts of land cover and land use change**
- **Enable informed decision making concerning resource use**
- **Enable improved land cover or land use management**

New or Improved Methods Might:

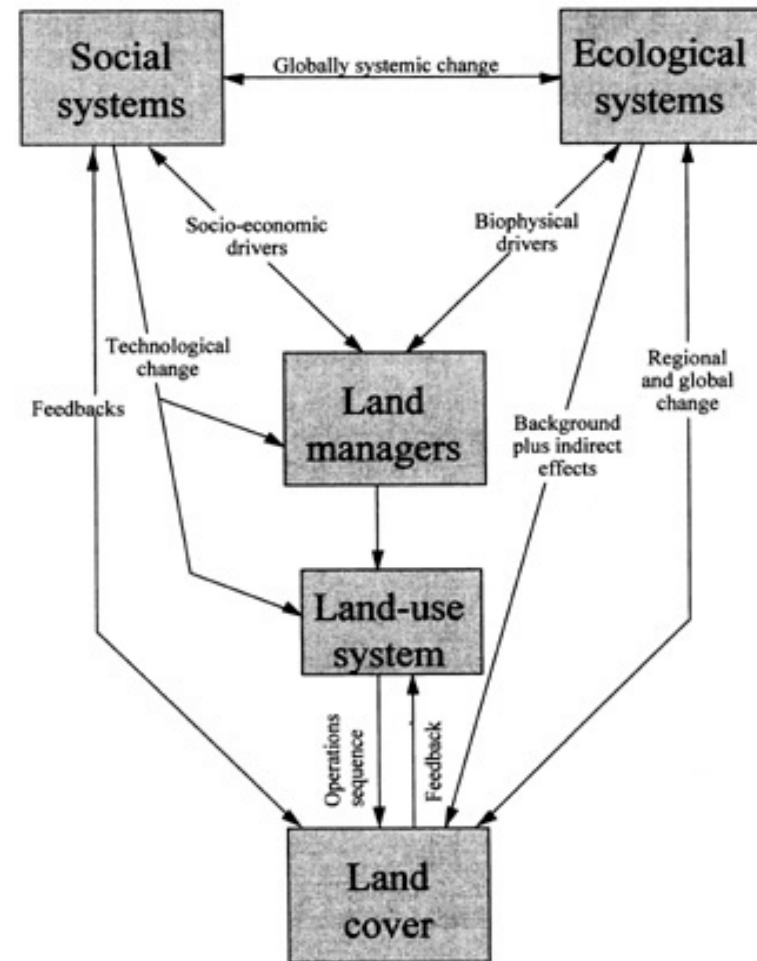
- **Involve new or improved data collection techniques**
- **Involve new or improved data processing and analysis approaches**
- **Provide an independent validation of a model or derived data products**
- **Provide an improved model or predictions capability**
- **Enable improved assessments of land cover or land cover change**
- **Enable remote determination of land use**

Concept and Theory of LCLUC

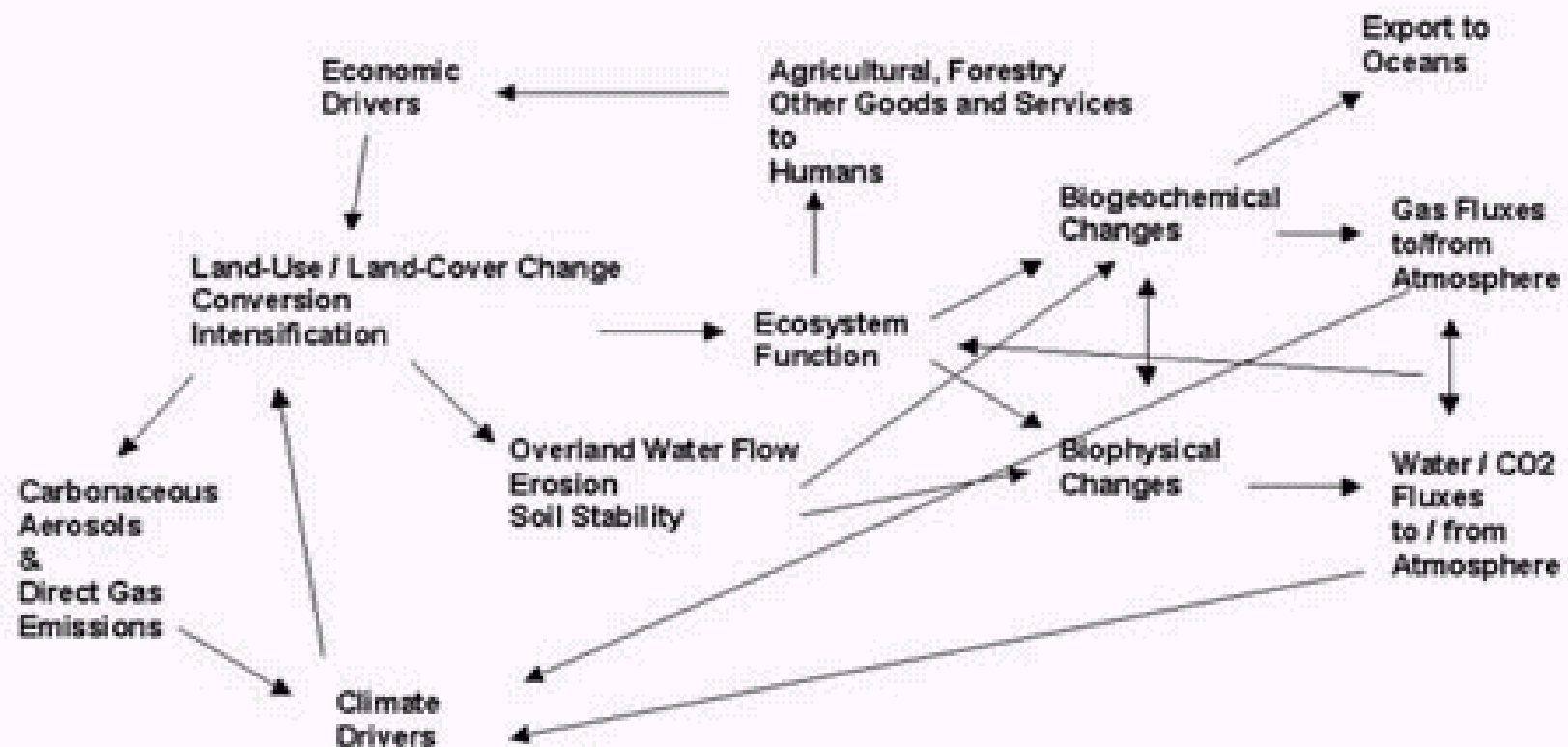
Multiscale Driving Forces in Land Use/Land Cover Change



Framework for Understanding Land-Use/Cover Situations



Interactions of Land-Use/Land-Cover Change



Current Status of the LCLUC Program

Land Cover and Land Use Change and Global Change

- **LCLUC is the most immediate and visible form of environmental change**
- **Little has been developed in terms of the underpinning science of LCLUC, understanding the impacts of LCLUC and predicting LCLUC**
- **LCLUC will continue to be important for the foreseeable future, driven by the demand for land, world population growth, the need for an increased food supply and wood products**
- **LCLUC contributes to climate change e.g. source of greenhouse gases**
- **LC and LU are impacted by climate change - effect of interannual, decadal and centennial climate variability and trends on land cover and land use**
- **LC and LUC can have an impact on the provision of ecological goods and services e.g. food supply, water quality, biodiversity**

Context for NASA's LCLUC Program

USGCRP Overall Goal

- **Observe, understand, predict, and assess the critical natural and human-induced dynamic states and trends of the Earth's global environmental system across a wide range of time and spatial scales**
- **Address those uncertainties and gaps in scientific knowledge central to the Nation's global environmental change policy interests**
- **Deliver timely information and data products essential to informed decision making that protects the environment, enhances socioeconomic development, and ensures a sustainable future for the Nation and the world**

USGCRP Program Elements

- Understanding the Earth's Climate System
- Biology and Biogeochemistry of Ecosystems
- Composition and Chemistry of the Atmosphere
- Paleoenvironment/Paleoclimate
- Human Dimensions of Global Change
- The Global Water Cycle
- Carbon Cycle Science

LCLUC and Carbon

- **Much of the current emphasis on LCLUC has come through attention being given to the carbon cycle - estimation of the sources e.g. rates of tropical deforestation national anthropogenic emissions estimates from land use**
- **Attention is now turning to quantifying sinks - associated with recovery of previous disturbance e.g. tropical regrowth, northern hemisphere 200 yr historical land use, modeling initiatives**
- **The FCCC is giving increased visibility to carbon budgets and trading opportunities, new research initiatives on carbon sequestration are likely - human use of the land will need to be factored in. Increased attention being given to carbon and land management - issues of the Clean Development Mechanism (CDM)**
- **There will ultimately be a need for an independent 'carbon' monitoring system.**
- **Although carbon has dominated the discussion, human alteration of the nitrogen cycle is significant as are other trace gases**
- **Carbon will continue to dominate the 'policy arena' for some time to come**

USGCRP Phase II Objectives

- The need to broaden and advance the earth sciences research agenda to embrace the whole-system problem of a dynamical **climate system** coupled to a complex and diverse set of large scale **ecological systems**, both interacting on multiple time and space scales with omnipresent human **socioeconomic systems** and their effects.
- The need to study systematically **how these interactions constrain human activity and how a predictive understanding of them creates the opportunity to make economic systems more efficient**, enabling - rather than hindering - development.
- The need to organize in a way which will ensure, nationally and internationally, the capacity of the scientific community to deliver on a continuing basis, beginning now and constantly improving in quality, the information products needed **to enable informed decisions about resource management and economic issues** in a broad spectrum of decision frameworks worldwide, both public and private.

USGCRP and Land Cover and Land Use Change (Our Changing Planet - FY 2000)

- **Biology and Biogeochemistry of Ecosystems: key research challenges**
 - Changing Land Use and Land Cover
 - relationship between LCLUC and weather/climate
 - relationship between climate change and LCLUC
 - the effects of LCLUC on ecosystems, hydrology, species distribution and human social systems
 - Changes in Global Nitrogen Cycle
 - *Multiple stresses of ecosystems*
- **The new USGCRP Carbon Cycle Initiative includes:**
 - Effect of past and current land use change on carbon storage
 - Inventory and long term monitoring of carbon stocks

US/GCRP Carbon Cycle Science Initiative

Long Term Goals:

QUANTIFY

Partitioning of CO₂ between ocean and terrestrial sinks

Spatial and temporal distribution of sources and sinks on a regional scale

UNDERSTAND

Processes that control source and sink distribution

Factors that regulate net sequestration of anthropogenic CO₂

PREDICT

Lifetime, sustainability and variability of sources and sinks of CO₂



NASA LCLUC Components

- **Forcing Factors**
 - Climate and Ecological Drivers
 - Socioeconomic Drivers
- **Responses and Consequences**
 - Land cover conversion, abandonment
 - Land use intensification
 - Land degradation
 - Landscape fragmentation
- **Modeling and Implications**
 - LCLUC modeling
 - coupled modeling of biogeochemistry e.g. carbon/nitrogen/trace gases
 - modeling land atmosphere interactions
- **Technique Development**
 - Remote Sensing R and D
 - Data Management
 - In-situ data collection - surveys / validation / process studies

NASA LCLUC: current situation

- **Tony Janetos and Bob Harriss have left NASA**
- **Jon Ranson 6 month secondment from GSFC as Project Manager - Justice remains Project Scientist**
- **New NASA science management less familiar with LCLUC concepts**
- **Janetos replacement in process**
- **LCLUC NRA due any day now**
- **CEOS Global Observation of Forest Cover emerging**
- **LBA and SAFARI 2000 campaigns underway - GCIP in progress**
- **NASA Strategic Planning document drafted**
- **Planned Missions - Landsat 7, Terra, EO1, EOS PM, VCL**
- **New missions pending - Landsat follow on, NPP, Recovery, NPOESS, LightSAR**
- **EOS DIS/ DAACS, PI processing, ESIPS and New DIS**
- **Relationship with other NASA elements e.g.**
 - **Instrument teams**
 - **R and A Ecol/Biogeo, Hydrology**
 - **Data systems, Commercial Data Buy,**
 - **Applications Program**

- **Why should NASA have a LCLUC element ?**
 - NASA sensing systems provide data essential to the inventory and monitoring of land cover. Remote sensing is the only way to provide some of the necessary data sets
 - There are compelling GC research questions of LCLUC that can in part be addressed by remote sensing. LCLUC is highly relevant to society
 - The study of LCLUC at regional to global scales provides a data management challenge. NASA is investing in advances in data management and distribution
- **Do we need and can we create an LCLUC funding wedge ?**
 - As a new activity for NASA need to justify the existing investment and make the case for continued or increased funding
 - Need a continued clearly articulated rationale for LCLUC
 - Need to package the program results and future directions for the research in an easily understandable and compelling way
- **How do we secure the LCLUC mission needs ?**
 - Landsat 7 / Terra / PM
 - The rationale and specifications for future missions

Strategic Questions

(1) What is the current distribution of global land cover and how is this changing?

(2) What are the interrelationships of interannual climate variability and land cover change?

(3) What are the driving forces behind land cover and land use change and how do past land cover distribution and land use changes affect the current distribution of land cover and land use?

(4) What are the consequences of land cover and land use change on biogeochemical cycling, biophysical processes, and biodiversity of ecosystems?

(5) What are the implications of natural and anthropogenic disturbances on the carbon cycle?

The Role of the LCLUC Science Team

- **Generate high quality individual or collaborative research - peer reviewed articles**
- **Teamwork is needed to make the program goals - interdisciplinary skill mix / broad experience base / regional expertise**
- **The program needs highly visible results and contributions:**
 - responsive program e,g, OSTP
 - up to date LCLUC WEB site
 - regional CD's
 - IPCC contributions
- **The Science Team needs to help justify the existing investment and make the case for continued or increased funding for the study of LCLUC**
 - up to date summary presentation material
- **Need to package the program results and articulate future directions for the research in an easily understandable and compelling way**
- **Need to contribute to the advance of the LCLUC 'discipline'**



LCLUC and Global Observation of Forest Cover

- **The CEOS GOFC Pilot Project**
 - provides an opportunity to secure long-term ‘operational’ systems to support the study of land cover change - focus on global change / carbon cycle data needs
 - operational pilot for the Integrated Global Observing System
- **Forest Cover and Cover Change**
 - Combines global coverage at moderate resolution (1km-250m) with targeted regional coverage at high resolution (30-10m) and sample hyperspatial resolution data (<10m)
 - Wall-to-wall high resolution coverage of forests every 5 years;
- **Forest Fire Mapping and Monitoring**
 - Active fire detection, burn scar mapping, multi-source satellite data
 - Web based data delivery systems
- **Forest Biophysical Functioning**
 - Methods and algorithms for LAI/ fPAR/ NPP, above ground biomass, vegetation composition and structure
 - Creation and validation of regional/global data fields



LCLUC - Landsat 7



- Landsat 7 is a critical component of the LCLUC program
- Permitting periodic assessments of land cover and land cover change
- Continuing the long- term high resolution record - mid 80's
- LCLUC will contribute to the science rationale for a Landsat follow-on
- Issues
 - Need an effective global acquisition strategy - repeated coverage
 - Need for data processing and distribution capability
 - Landsat Pathfinder Humid Tropical Forest Project
 - Need methods for large area mapping
 - Need relationships with foreign ground stations
 - Need to explore cost efficient ways for providing data

EOS and LCLUC

- **EOS Terra (July launch ??) - new sensors for the study of LCLUC**
- **MODIS - AM/PM (2330 km swath)**
 - **Land Cover Parameterization (UMd) - Townshend and DeFries**
 - **Land cover change (UMd) - Townshend and DeFries**
 - **Fire and Burned Area (UVA/UMd) Justice/Roy**
 - **Land Cover and Interannual Variability (BU) - Strahler**
 - **BRDF (BU/UCL) - Strahler / Muller et al.**
- **ASTER (60km swath)**
 - **Spectral range: VNIR 0.5-0.9 μm , SWIR 1.6-2.5 μm , TIR 8-12 μm**
 - **Spatial resolution: 15 m (VNIR: 3 bands), 30 m (SWIR: 6 bands), 90 m (TIR: 5 bands)**
- **MISR (360km swath)**
 - **Spectral bands 446, 558, 672, 866 nm**
 - **BRDF / Vegetation Structure**